Case Study: Energy Audit in STMicroelectronics

Background

STMicroelectronics is a global independent semiconductor company and a leader in developing and delivering semiconductor solutions across the spectrum of microelectronics applications.

There is a strong corporate dedication towards environmental responsibility and this has resulted in substantial reductions in the consumption of energy, water, paper and hazardous chemicals, increased recycling of waste products and a significant cut in CO2 emissions.

Energy

- To continue to reduce total energy consumption (normalized per wafer) by at least 5% per year, through process and facilities optimization, conservation and building design.

Greenhouse Gas Emissions

- To be a **completely neutral company** in **2010** as far as greenhouse gases are concerned

- CO2: To reduce total emissions due to energy consumption (tons per carbon equivalent) by at least a factor of 10 in 2010 vs. 1990 levels

- Carbon sequestration: To compensate the remaining CO2 emissions due to energy consumption through reforestation

Renewable and Alternative Energy

- Renewable Energy: To increase utilization (wind, photovoltaics and solar thermal) so that they represent at least 5% of total energy supplies by end 2010

- Alternative Energy: To adopt, wherever possible, alternative energy sources such as cogeneration and fuel cells

Optimization of Chilled Water System - AMK 8 Experience

- Connection to power grid – 15th August 2000 and started to use electricity generated by natural gas late 2001

- Ramp up phase ~ approx. a year

- Carried out detailed energy audit in September 2001 to identify potential improvement opportunities in energy efficiencies by fine-tuning the plant from the design conditions. An energy service company (ESCO) was engaged to offer professional services for the energy improvement projects

- Fine-tuning was done without compromising the production environment and quality. Changes were evaluated for potential impact prior to implementation

- The energy-saving projects were implemented in 2 phases:-
  - Free phase – process optimization
  - Cost phase – capital investment in energy efficiency improvement projects

Focus of Energy Audit

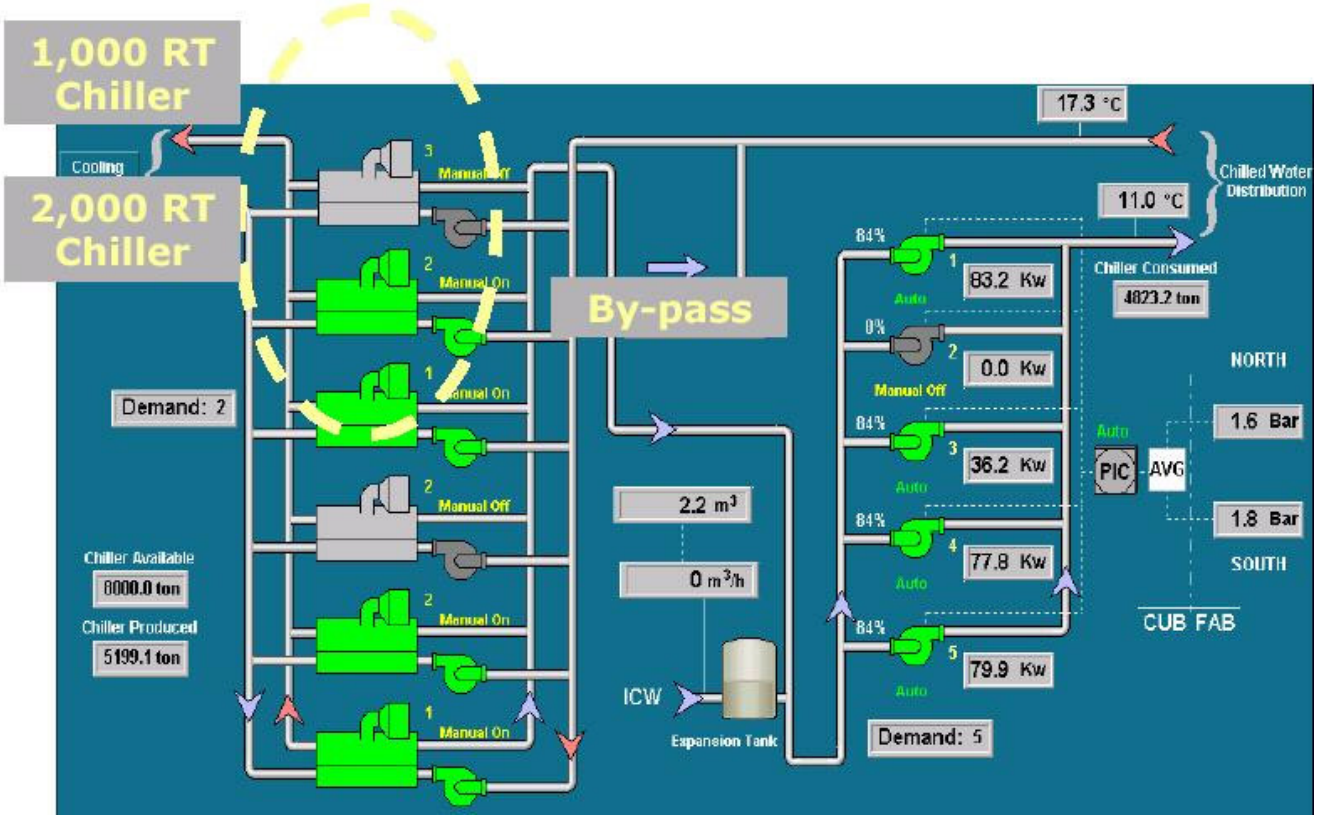
- As high-energy consumption of chillers is a common issue in all facilities, STMicroelectronics started looking at the possibility of improving the chilled water production efficiency

- Actual load of 2,300 RT served by 2 operating chillers (1 x 2,000 RT and 1 x 1,000 RT)

- Is it possible to meet the actual load using a single 2000 RT chiller?
  - Through computer simulation by chiller supplier, the 2,000 RT chiller is found able to be loaded at 2,300 RT at 100 % with the chilled water and condenser temperature supply at 13^{o}C and 28^{o}C respectively, with the input power at 1,053 kW and increased condenser flow at 1,588 m3/hr

- To operate the single 2000 RT chiller, 3 conditions are to be met:
  - To increase the condenser water flow and lower the condenser water supply temperature
  - To increase the chilled water flow
  - To achieve input power at 1,053 kW

Chilled Water System Configuration



- Primary Chilled Water and Secondary Chilled Water System
- Single Chilled Water System with customized Makeup Air Handler c/w integrated DX refrigeration system
- The chiller plant consists of 1 x 1,000 RT Chiller and 5 x 2,000 RT Chiller which are installed in 3 phases
- Designed chilled water distribution temperature is 12°C

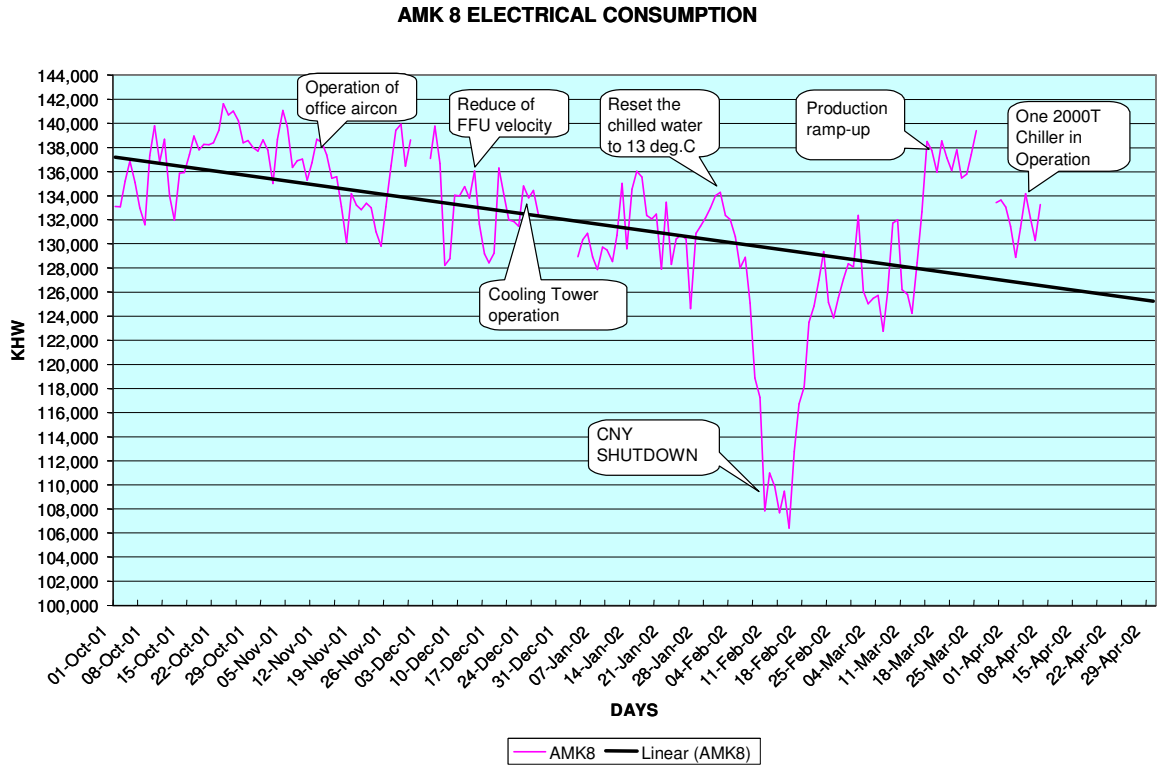
How does STMicroelectronics achieve the 3 conditions?

- To increase the condenser water flow
  - Removal of triple duty valves and operating all 6 units of cooling tower (including redundant units) to achieve 28°C
  - The condenser water flow increased from 1,431 m3/hr to 1,588 m3/hr by reducing pipe frictional loss
- To increase the chilled water flow and reset the chilled water to 13°C
  - Allowing a variable chilled water flow to the chiller by closing the bypass valve between the primary and secondary distribution loop

- The chilled water flow increased from 680 m^3/hr to 914 m^3/hr

- To achieve input power at 1,053 kW
  - Reset HT protection setting on the breaker after studying the motor characteristics and confirmation from the supplier that there is no detrimental effect in running the motor at the higher power rating

Achievements



- Able to operate a single chiller at **115 %** with improvement in the **chiller efficiency** from 0.529 to **0.458 kW/Ton**

- The electricity savings is **S$280k per year**

- **Reduces energy consumption** and **CO2 emissions**

Conclusion

The experience highlighted the importance of maintaining a constant awareness for the need to continuously improve energy efficiency, and to look beyond the design conditions of systems to evaluate any possibilities for improvement in energy efficiency.

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